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UTILITY
OPERATION AND SERVICE
INSTRUCTIONS



# INSTRUMENTATION CONSOLE

# Project 9040

NOVEMBER 1962

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SECTION I

INTRODUCTION AND DESCRIPTION

1-1. INSTRUMENTATION CONSOLE MANUAL.

1-2. SCOPE. This manual is intended for use by personnel responsible for the operation and maintenance of the Instrumentation Console.

1-3. PURPOSE.

1-4. GENERAL. The purpose of the Instrumentation Console (figure 1-1) is to provide the facilities for checking voltages and waveforms of equipment in the 9040 project. As such, the Console is used in conjunction with the other items of Ground Support Equipment.

1-5. DESCRIPTION.

1-6. GENERAL. The Console is a metal enclosure 71¼ inches high, 24 inches wide, and 26 inches deep; it is mounted on casters which allow the required mobility within the work area and permit the operator to position the equipment for best control and viewing convenience. The following items of rack-mounted equipment are contained in the Console:

a. Wide-range, general-purpose Oscilloscope
b. Automatic Ranging A.C. to D.C. Converter
c. Digital Volt-Ohm-Ratiometer
d. Hewlett-Packard V.H.F. V.T.V.M.
e. Blower Unit
f. Power Distribution Unit.

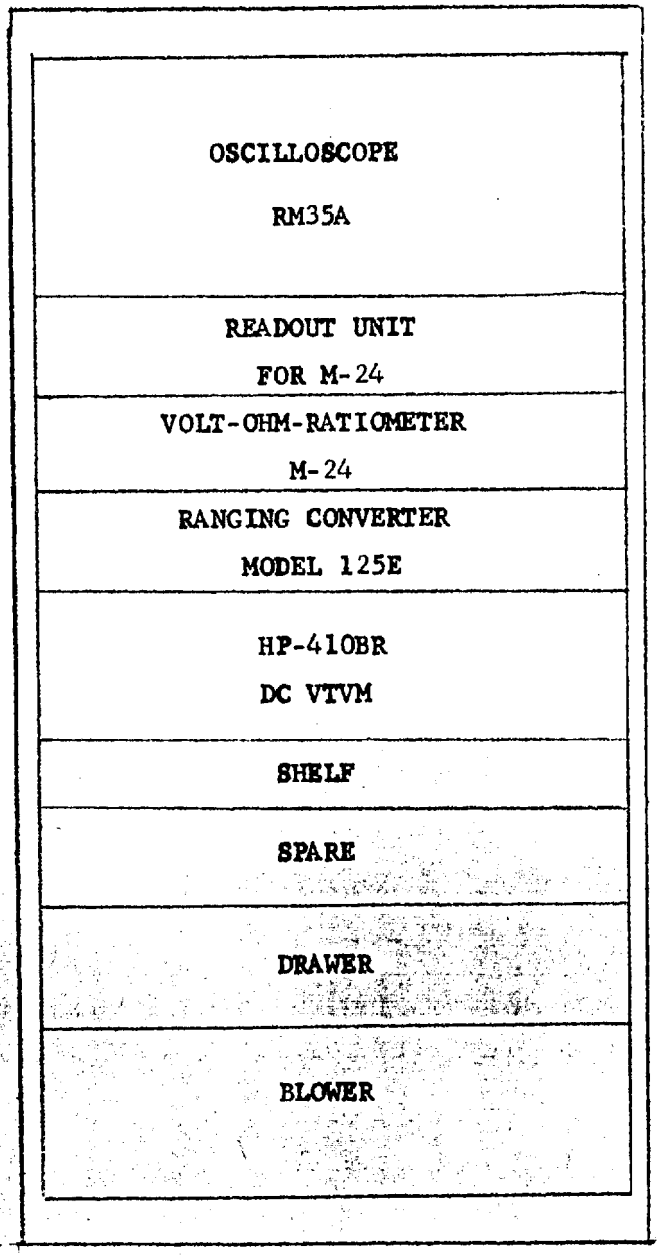


Figure 1-1. Instrumentation Console

1-7. OSCILLOSCOPE. The Tektronix Type RM35A Oscilloscope is the top unit in the Console rack. This instrument is a wide-range, general-purpose device that permits accurate measurements of voltages, frequencies, and times in the dc to 15-mc range. The dual-channel input of the Type CA plug-in preamplifier unit permits simultaneous observation and measurement of the ac and dc components in two input waveforms. Provision is made for adding or subtracting these waveforms as desired. A delay feature enables the operator to select any amount of time, between 1 microsecond and 10 seconds, by which the presentation of the sweep will lag behind the triggering impulse. This feature permits observation of a small portion of the normal sweep, accurate measurement of waveform jitter, and precise time measurements.

1-8. Triggering of the horizontal sweep is provided by either of two time-base circuits, but external triggering can be used if desired.

1-9. A magnifier circuit provides a 5-times expansion of the center 2-centimeter portion of the Oscilloscope display.

1-10. The cathode-ray tube has a 6-centimeter by 10-centimeter usable viewing area. An edge-lighted graticule is marked with 6 vertical and 10 horizontal 1-centimeter lines; the horizontal and vertical centerlines are subdivided into 2-millimeter markings.

1-11. An amplitude calibrator provides 1000-cycle square waves for either internal or external use, as desired. These are variable from 0.2 millivolt to 100 volts.

1-12. AUTOMATIC RANGING CONVERTER. The Non-Linear Systems, Inc. Model 125E ac to dc Automatic Ranging Converter when used with the Digital Volt-Ohm-Ratiometer described below permits precise and automatic measurements of ac voltages. Precise measurements are assured by the high input impedance of the converter. The likelihood of error is further reduced because the voltage readings which are clearly visible at distances up to 30 feet, can be taken by untrained persons.

1-13. The converter has a signal attenuator, signal amplifier, logic circuits, filters, a summing network, and correction amplifiers. Semi-conductor diodes are used to convert the unknown ac input into pulsating dc. After proper filtering and processing, a pure dc is applied to the digital voltmeter.

1-14. The ac input ranges are: 10,100,and 1000 volts, with a frequency range of from 30 cps to 10 kc. Accuracy of ac to dc conversion (percent of full scale on each range): scale multiplier accuracy, voltage linearity, and frequency effect $\pm$ 0.1 percent. Input impedance is 10 megohms with 40 uuf shunt capacitance.

1-15. DIGITAL VOLT-OHM-RATIOMETER. The Non-Linear Systems, Inc. Transistorized Digital Volt-Ohm-Ratiometer Model M-24 is a high-speed four-digit instrument designed specifically for systems checkout.

1-16. The Model M-24 Digital Volt-Ohm-Ratiometer consists of two modules, referred to as an "A" unit and a "B" unit. The "A" unit which is readily identified by the readout on the front panel includes transistor and diode-type logic circuits, a differential amplifier, a precision feedback bridge, and readout memory circuits. High accuracy, speed, and reliability of the instrument are obtained by the utilization of semiconductors and mercury-wetted relays.

1-17. The "B" unit which is readily identified by the control knobs on the front panel contains the power supply, a reference source, sensing amplifier, and range and function switching relays. The Model M-24 utilizes two regulated power supplies, one supplying -27.5 VDC and +33 VDC: while the other supplies +250 VDC, +150 VDC, and -250 VDC.

1-18. The ac ranges which are automatically selected are: 1,10, and 100 volts. The accuracy of the reading is $\pm$ 1 digit. Input impedance is 10 megohms for dc volts, and 1000 megohms for dc ratios.

1-19. VACUUM-TUBE VOLTMETER. The Hewlett-Packard Model 410BR VTVM is a rack-mounted version of the standard Model 410B instrument. This laboratory-quality device provides the means for measuring resistances, dc voltage up to 1000 V, and ac voltage (in the 20-cps to 700-mc range) up to 300V using the V.H.F. probe.

1-20. Full-scale ac ranges of 1, 3, 10, 30, 100, and 300V are provided. The full-scale dc ranges are 1, 3, 10, 30, 100, 300, and 1000V. The ohmmeter ranges have mid-scale values of 10, 100, 1000, 10,000, 1,000,000 and 10,000,000 ohms. DC input resistance is approximately 122 megohms on all ranges.

1-21. All dc ranges, and the ac ranges of 10V and above, are read on two black scales, calibrated 0-1 and 0-3, respectively. The 1-V and 2-VAC ranges are read on special scales. All resistance readings are made on one OHMS scale.

1-22. BLOWER UNIT. The Western Devices Model SC-1236-2 Blower Unit is a standard commercial item. An impeller-type fan draws room-temperature air through an air-filter at the front of the unit and forces an upward flow of air through louvers at the top surface of the Console. A single-phase, 1/4-horsepower motor drives the fan and provides an air flow of 600 to 900 cfm.

1-23. POWER DISTRIBUTION UNIT. Mounted at the bottom-rear of the Instrumentation Console, the Power Distribution Unit provides the connector for the 120/208-volts, 3-phase, 60-cycle primary power, and the wiring for distributing one phase of this supply voltage to the equipment packages in the Console.

1-24. FUNCTIONAL OPERATION.

1-25. GENERAL. The Instrumentation Console, in conjunction with other items of the Ground Support Equipment, provides the means for measuring the voltages, waveforms, time durations, and phase relationships that are of importance to the checkout, operation, and maintenance of the 9040 equipment.

1-26. OSCILLOSCOPE. For a complete description of the oscilloscope, refer to the Tektronix, Inc., "Instruction Manual for Type 535A, 545A Oscilloscopes."

1-27 AUTOMATIC RANGING CONVERTER. For a complete description of the Automatic Ranging Converter, refer to the Non-Linear Systems, Inc., "Instruction Manual for Model 125E AC to DC Automatic Ranging Converter."

1-28. DIGITAL VOLT-OHM-RATIOMETER. For a complete description of the Digital Volt-Ohm-Ratiometer, refer to the Non-Linear Systems, Inc., "Instruction Manual for Transistorized Digital Volt-Ohm-Ratiometer, Models M-24 and V-24".

1-29. VACUUM-TUBE VOLTMETER. For a complete description of the Vacuum-Tube Voltmeter, refer to the Hewlett-Packard Co., "Instruction Manual for Model 410B Vacuum-Tube Voltmeter."

1-30. BLOWER UNIT. The Blower Unit for the Instrumentation Console provides an air flow of 600 to 900 cfm in the Console. Blower intake is through a filter and grille at the Console front panel, and blower output is through a 6-inch wide by 7½-inch high port in the side of the Unit. From the port, the air flows into a wide, shallow duct installed in the space between the side of the Blower Unit and the left side of the Console. The inside wall of this duct is perforated by numerous holes which direct the air flow into the space between the several units of equipment.

1-31. POWER DISTRIBUTION UNIT. (See Schematic E36263.) Primary power for the Console (120/208V, 60-cycle, 3-phase) is supplied through a heavy-duty cable which terminates at a 4-prong connector. This connector is mated with the heavy-duty connector mounted on the panel of the Power Distribution Unit.

1-32. The 3-phase input goes through a panel-mounted circuit breaker of the manual-reset type. At the output side of the breaker one phase is tapped off to feed four convenience outlets, also panel-mounted. The 3-phase power from the circuit breaker goes to a 4-pole, 2-position contactor that is energized when the circuit breaker is set to the ON position. One pole of the contactor closes a 120V interlock circuit. Since the contactor control leads pass through the Console interlock, no power can be applied to the equipment in the Console if the interlock is open.

1-33. From the contactor, the 3-phase power is split three ways, with each phase feeding a 3-element female receptacle. One receptacle is connected by a flexible cable and male plug to an associated raceway which is mounted vertically along the corner post of the Console. The individual equipment packages are then connected to convenient outlets of the raceway by means of the power leads provided with the equipment.

NOTE

Although the Power Distribution Unit is designed with three single-phase receptacles for associated raceways, only one receptacle and raceway is used in the Instrumentation Console.

1-34. The following tabulation of data on the Power Distribution Unit is provided for quick reference:

| | |
|---|---|
| Input: | 120/208V, 3-phase, 60-cycle, 5-wire |
| Circuit breaker: | 3-phase, manual-reset type |
| Contactor: | 4-pole, 2-position, 120V solenoid |

1-35. POWER REQUIREMENTS. The following tabulation of data on the power requirements for the Instrumentation Console is provided for quick reference:

| | |
|---|---|
| Oscilloscope | 500 w, 105-125 VAC, 50-60 cps |
| Automatic Ranging Converter | 70 w, 115 VAC, 60 cps |
| Digital Volt-Ohm-Ratiometer | 105-125 VAC, 60 cps with earth-ground available |
| Vacuum-Tube Voltmeter | 40 w, 120 VAC, 50-1000 cps |
| Blower Unit | 1/4-hp, 120 VAC, single-phase |

1-36. EQUIPMENT LIST.

1-37. EQUIPMENT SUPPLIED. A list of equipment supplied as part of the Instrumentation Console is provided in Table 1-1.

Table 1-1. Instrumentation Console, Equipment Supplied

| Nomenclature | | | Overall Dimensions* | | | |
|---|---|---|---|---|---|---|
| Qty | Name | Designation | Height | Width | Depth | Weight |
| 1 | Oscilloscope | RM35A | 14 | 19 | 22 | 32-3/4 |
| 1 | Automatic Ranging Converter | 125E | 3½ | 19 | 15½ | 27 |
| 1 | Digital Volt-Ohm-Ratiometer | M-24<br>V-24 | 5¼ | 19 | | |
| 1 | Vacuum-Tube Voltmeter | 410BR | 7 | 19 | 5-7/8 | 19-3/4 |
| 1 | Blower Unit | SC-1236-2 | 8-3/4 | 19 | 15½ | 51 |
| 1 | Power Distribution Unit | - | 7 | 19 | 6-1/16 | 12½ |

* Dimensions are in inches and weight in pounds.

SECTION II

SPECIAL SERVICE TOOLS

2-1 OSCILLOSCOPE TOOLS.

2-2. The RM35A Oscilloscope is the only instrument of the Instrumentation Console requiring special tools. These alignment tools are supplied with the Oscilloscope as follows:

| Quantity | Name | Designation |
|---|---|---|
| 1 | Insulated screwdriver | Tektronix No. 003-000 (Jaco No. 125) |
| 1 | Insulated screwdriver | Tektronix No. 003-001 (Jaco No. 125) |
| 1 | Insulated alignment tool | Tektronix No. 003-003 (Walsco No. 2519) |
| 1 | Variable-inductor adjustment kit. | Tektronix No. 003-007 |

SECTION III

PREPARATION FOR USE

3-1. UNPACKING AND HANDLING.

3-2. UNPACKING. For shipment, the Instrumentation Console is disassembled only to the extent necessary to prevent damage to the major units. The Console cabinet, Power Distribution Unit, blank panels, etc., are in a large wooden crate. The Oscilloscope, Digital Volt-Ohm-Ratiometer, Automatic Ranging Converter, and Vacuum-Tube Voltmeter are individually packed and crated in three smaller containers.

WARNING

When uncrating, use a nail-puller rather than a hammer to avoid damage to the equipment.

3-3. Uncrate the large unit first. Set the cabinet in a vertical position on the dolly platform and remove any packing material still remaining. Assemble the console work surface to the cabinet.

3-4. INSPECTION. Next, uncrate the equipment packages and inspect equipment for damage. If no damage is noted, make preliminary bench tests on the Oscilloscope, Automatic Ranging Converter and Digital Volt-Ohm-Ratiometer, Vacuum-Tube Voltmeter, using appropriate manuals as a guide.

NOTE

Each Console unit was checked and calibrated before shipment.

3-5. INSTALLATION.

3-6. CONSOLE. The Instrumentation Console will be used as required at various locations in the area provided for ground checkout operations. The dolly mounting provides the required mobility and enables the operator to turn the Console for best working and viewing convenience.

3-7. Install the Vacuum-Tube Voltmeter, The Automatic Ranging Converter, the Digital Volt-Ohm-Ratiometer, and the Oscilloscope in the Console rack. Place the Oscilloscope on the chassis tracks provided, slide the unit back until the panel is flush, and secure with the four captive screws. Then mount the two sub-units of the Digital Volt-Ohm-Ratiometer and the Automatic Ranging Converter, using the captive screws on each to secure. Last, mount the Vacuum-Tube Voltmeter, using its captive screws.

3-8. UNIT CONNECTION. To make the unit connections, proceed as follows:

a. Open the back panel of the Console and check that the power plug of the Blower Unit is inserted in the raceway.

b. Plug the power leads from the Oscilloscope, the Vacuum-Tube Voltmeter and the power chassis of the Digital Volt-Ohm-Ratiometer into the raceway.

c. For interconnection of the Automatic Ranging Converter and the Digital Volt-Ohm-Ratiometer, refer to Non-Lineary Systems, Inc., "Instruction Manual for Model 125E AC to DC Automatic Ranging Converter" page 9, and Transistorized Digital Volt-Ohm-Ratiometer Models M-24 and V-24, Block Diagram Drawing Number 10050.

3-9. PRIMARY POWER. Primary power is supplied to the Console by a 5-wire flexible cable that plugs into the power receptacle on the panel of the Power Distribution Unit. Power required for the Instrumentation Console is 120/208V, 3-phase, 60 cycle.

3-10. A two-position ON/OFF circuit breaker is used to energize the Power Distribution Unit. The circuit breaker is a three-phase, three-pole switch with a manual-reset feature. Table 3-1 lists the functions of its indicators.

3-11. ENERGIZING THE CONSOLE.

3-12. The following procedure is used in energizing the Instrumentation Console:

a. Make sure that the manual-reset circuit breaker is in OFF position.

b. Plug main power cable into 120/208V, main-power receptacle on panel.

c. See that the door of the Instrumentation Console is closed.

d. Throw circuit breaker into ON position.

e. See appropriate manuals for information on energizing the individual instruments.

3-13. DE-ENERGIZING THE CONSOLE.

3-14. The Console is de-energized in the following manner:

a. Oscilloscope POWER ON switch to OFF position.

b. Digital Volt-Ohm-Ratiometer POWER switch to OFF position.

c. VTVM SELECTOR switch to OFF position.

d. Power distribution Unit ON/OFF circuit breaker to OFF position.

e. See appropriate manuals for information on de-energizing the individual instruments.

Table 3-1. Power Distribution Unit, Panel Controls, Indicators, and Connectors.

| Control/Indicator | Position | Function |
|---|---|---|
| 3-phase circuit breaker | ON/OFF | (Manual-reset type); to protect Console against overloads. |
| 120/208V 3-phase, 20-amp connector | | Semi-enclosed, male-type, 3-phase, 5-wire connector for main-power input to Console |
| Convenience outlets (4) | | To provide single-phase, 120V, 60-cps power for utility purposes. |